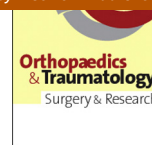




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Technical note

Soft-tissue coverage of olecranon with musculocutaneous flexor carpi ulnaris flap



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ABSTRACT

Coverage of the olecranon area is always challenging in traumatology. Because of the superficial situation of the bone, the absence of muscle, the thinness of the skin and the subcutaneous tissue locally, skin defects are not uncommon and can lead to exposure of hardware or prostheses. We report an original surgical technique using a musculocutaneous flap from the flexor carpi ulnaris (FCU) with a proximal pedicle to cover the olecranon area, detailing its limits and indications. The FCU flap has become our first-choice procedure to cover olecranon skin defects because of its low morbidity, its reliability, and its straightforward procedure, obviating the need for any microsurgery technique. Furthermore, it allows moving the elbow, immediately decreasing the risk of elbow stiffness.

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1. Introduction

Treatment of tissue loss in the olecranon area is a challenging clinical situation in traumatology and orthopaedics [1–4]. The local anatomic conditions are unfavorable with a bone structure protected only by a thin layer of skin, without a thick muscular environment and a thin panniculus adiposus. In addition, the skin tension varies with the position of the elbow, increasing when the elbow is in flexion, which can be a postoperative constraint limiting early mobilization of the elbow (an essential component of treatment to optimize the functional result).

Tissue loss is generally limited and is longer than it is wide. As a rule, local surgical coverage solutions are sufficient [5,6]: muscle flaps (anconeus [7] and brachioradialis) or fasciocutaneous flaps (antebrachial ulnar or radial, interosseous, lateral brachial).

Herein, we present a technical note on coverage of the olecranon area using a simple, rapid, reliable technique that does not require microsurgical techniques: the flexor carpi ulnaris (FCU) musculocutaneous flap with a maximum pedicle.

2. Surgical technique

2.1. Anatomical and vascular principles

The FCU muscle is a superficial muscle of the forearm. It includes two heads: humeral (inserting on the medial epicondyle) and ulnar

(inserting notably on the upper two-thirds of the posterior edge of the ulna with a tendinous flap). The muscle belly, whose mean length is 25.9 cm, descends vertically in the forearm and stops between 0.8 and 3.5 cm from the pisiform bone [8].

It receives its blood supply from the branches of [9]:

- the ulnar artery: a proximal pedicle at the first third of the muscle, and a distal pedicle at the tendon–muscle junction;
- the posterior ulnar recurrent artery: two or three pedicles penetrating the muscle at its proximal third.

The FCU muscle flap is harvested on its proximal pedicle coming from the ulnar artery. The distance between the olecranon and the pedicle's entry point in the muscle is approximately 5.9 cm; this pedicle is otherwise constant [8].

2.2. Skin paddle drawing

The ulnar crest as well as the reliefs of the pisiform bone and the FCU muscle tendon are drawn on the skin. The forearm is divided into three thirds. The skin paddle, centered on the muscle belly, is positioned at the distal part of the second third of the forearm. Its maximum width is 4 cm and it is 6–10 cm long.

2.3. Harvesting the flap

The distal edge of the skin paddle is incised first and the FCU tendon is identified. This phase makes it possible to reposition the skin paddle and to recenter it on the muscle belly if need be. The tendon is cut at its insertion on the pisiform. This pure tendon

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Fig. 1. X-rays of the elbow. Indirect visualization of the cutaneous substance loss facing the olecranon tip.

portion is used to anchor the flap securely at its receptor site, allowing early mobilization of the elbow. The other edges of the skin paddle are incised. The flap is harvested distally and proximally. The tendinous insertion plate of the ulnar arm is progressively resected. The dissection stops when the proximal vascular pedicle is identified. The entry point of the feeding vessels corresponds to the flap's rotation point. It is located approximately 6 cm from the olecranon tip. The flap is then turned 180° and placed without tension. Skin laxity generally allows direct closing at the wrist.

2.4. Clinical case 1

This 76-year-old right-handed female patient was treated for sequela of an AO type C open fracture of the distal humerus, initially treated with an external fixator. The initial Mayo Elbow Performance Score (MEPS) was 20 points, associated with algoneurodystrophic syndrome that had caused major stiffness in the wrist and homolateral fingers. A semi-constrained, cemented total elbow arthroplasty (Coonrad–Morrey) (Fig. 1) was decided, performed in a single procedure via the posterior Bryan–Morrey approach. The

systematic intraoperative bacteriological samples taken were sterile at 21 days of culture.

Two weeks after the intervention, the patient fell on the operated elbow, with direct injury to the olecranon, resulting in skin rupture and exposure of the olecranon and the implant. No fracture around the stems was identified. Emergency surgical revision was decided to clean the implants by disadaptation of the hinge without changing the humeral and ulnar stems. After skin debridement, the tissue loss measured 6 × 3 cm (Fig. 2). This was covered by a musculocutaneous FCU flap with a proximal pedicle in the same surgical procedure (Fig. 3). The elbow healed with no difficulty. The donor site was closed directly. Unrestricted mobilization was authorized immediately with no rehabilitation measures taken.

The clinical result at 3 years of follow-up is satisfactory with a MEPS score of 75 points and no radiological anomalies.

2.5. Clinical case 2

This 26-year-old male, right-handed patient, having sustained multiple injuries, initially presented an open transolecranon dislocation (Gustilo 2) of the left elbow. After reduction, lavage, debridement, and plate osteosynthesis, recovery was marked by major skin damage and exposure of the osteosynthesis material (Fig. 4).

Skin tissue loss after debridement measured 4 × 8 cm. The osteosynthesis material was removed and replaced by a simple transosseous tension band plate protected by an external fixator. The wound was covered with a FCU flap (Fig. 5) and healed in 3 weeks.

3. Discussion

Tissue loss generally occurs in the olecranon area in two clinical situations:

- in traumatology: fracture of the olecranon or distal humerus and primary or secondary exposure of the fracture site and/or the osteosynthesis material;
- in orthopaedics: exposure of the joint after prosthetic surgery, notably in a post-traumatic context with an elbow having

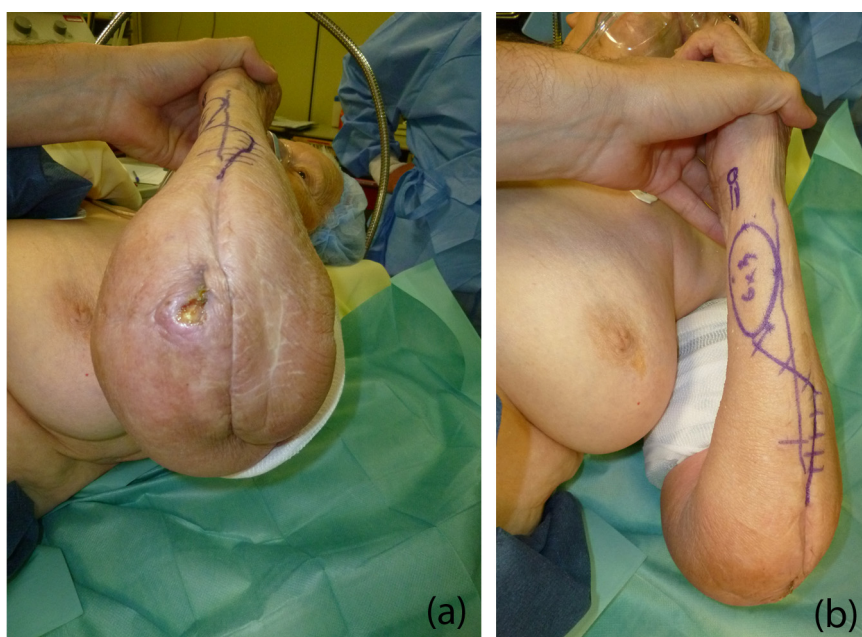


Fig. 2. a: bone exposure on an elbow with multiple scars; b: drawing of the skin paddle and flap approach.

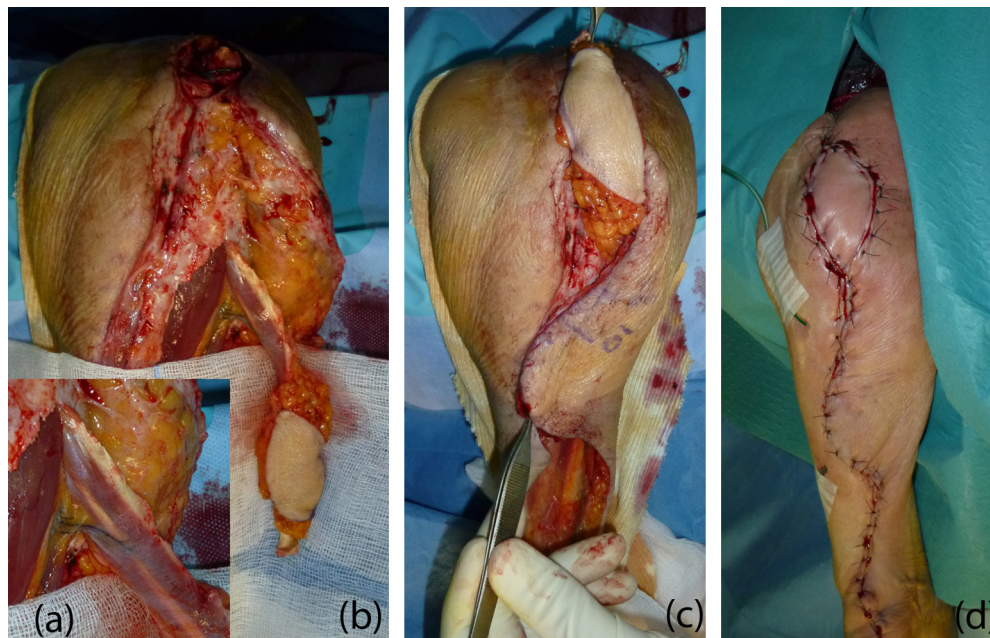


Fig. 3. a: visualization of the proximal vascular pedicle from the ulnar artery; b: harvesting of the musculocutaneous flap; c: placement of the flap at the receptor site; d: closing the donor site and positioning the flap.



Fig. 4. Exposure of the osteosynthesis material in the olecranon area.

sustained several surgical scars (from initial osteosynthesis approaches and any revisions).

Generally speaking, tissue loss is limited to a few centimeters in width. Scars from the previous interventions rule out the possibility of harvesting a local skin flap, such as an external brachial flap or an anconeus muscle flap.

Among the locoregional flaps, the posterior interosseous fasciocutaneous flap with a proximal pedicle [10] is a reliable technical solution, but the dissection requires experience. Recovery can sometimes be marked by venous engorgement and a period of uncertainty as to its viability.



Fig. 5. FUC flap coverage: aspect at 1 month.

Even if it is a reliable coverage solution, harvesting a brachioradialis muscle flap [11] cannot be retained as first-line treatment of an injured elbow because the brachioradialis is an important flexor.

The antebrachial radial [12] (or ulnar) flap is a simple and reliable technique; nevertheless, morbidity at the donor site (sacrifice of a major axis, skin graft on tendons) is considerable.

Harvesting a FCU musculocutaneous flap is relatively simple, rapid, and reliable, with no need for microsurgery and no dissection of the pedicle (it is simply visualized). With the proximal pedicle penetrating in the muscle approximately 6 cm from the olecranon, the dissection does not surpass this limit. If the skin's flexibility allows direct closing at the donor site, a pure muscle flap can be harvested and grafted as a thin skin layer at the same time.

The exact maximum size of the skin paddle is not known. Nevertheless, it should not exceed 4 cm in width so that it can close directly on the donor site. If the width of the skin tissue loss is greater than 4 cm, this is probably a poor indication for a FCU musculocutaneous flap. The site cannot be closed with a skin graft, which would be applied directly on the ulnar nerve. Theoretically, the length of the skin paddle is unlimited as long as it remains

centered on the muscle belly. In practice, it rarely exceeds 8 cm long.

In case the tissue loss involves the tricipital tendon, the continuity of the extensor apparatus can be re-established by suturing the FCU tendon to the remainder of the tricipital tendon [13].

The FCU muscle is the most powerful muscle for wrist flexion and abduction. If the other flexor and abductor muscles of the wrist are intact, there seems to be no significant repercussion on wrist function [14]. Nonetheless, given the absence of studies in the domain, we do not recommend this flap in a young patient with high functional demands.

Functionally, however, the FUC muscle is a bipennate muscle, with two distinct muscle parts, each with its own innervation and vascularization [15,16]. This anatomic configuration makes it possible to harvest a hemi-FCU [17] to minimize the impact on the wrist. In cases of partial harvesting, the tissue loss should not exceed 3 cm in width.

The FCU flap is a simple and reliable local technical solution, adapted to treating small- and moderate-sized cutaneous substance loss in the olecranon region. This flap provides good-quality coverage and allows early mobilization of the elbow.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References

- [1] Baecher N, Edwards S. Olecranon fractures. *J Hand Surg Am* 2013;38:593–604.
- [2] Ali A, Shahane S, Stanley D. Total elbow arthroplasty for distal humeral fractures: indications, surgical approach, technical tips, and outcome. *J Shoulder and Elbow Surg* 2010;19:53–8.
- [3] Kamineni S, Morrey BF. Distal humeral fractures treated with noncustom total elbow replacement. Surgical technique. *J Bone Joint Surg Am* 2005;87(Suppl. 1):41–50.
- [4] Jensen M, Moran SL. Soft tissue coverage of the elbow: a reconstructive algorithm. *Orthop Clin North Am* 2008;39:251–64 [vii].
- [5] Patel KM, Higgins JP. Posterior elbow wounds: soft tissue coverage options and techniques. *Orthop Clin North Am* 2013;44:409–17.
- [6] Stevanovic M, Sharpe F. Soft-tissue coverage of the elbow. *Plast Reconstr Surg* 2013;132:387e–402e.
- [7] Fleager KE, Cheung EV. The “anconeus slide”: rotation flap for management of posterior wound complications about the elbow. *J Shoulder and Elbow Surg* 2011;20:1310–6.
- [8] Payne DES, Kaufman AM, Wysocki RW, Richard MJ, Ruch DS, Leversedge FJ. Vascular perfusion of a flexor carpi ulnaris muscle turnover pedicle flap for posterior elbow soft tissue reconstruction: a cadaveric study. *J Hand Surg Am* 2011;36:246–51.
- [9] Parry SW, Ward JW, Mathes SJ. Vascular anatomy of the upper extremity muscles. *Plast Reconstr Surg* 1988;81:358–65.
- [10] Mazzer N, Barbieri CH, Cortez M. The posterior interosseous forearm island flap for skin defects in the hand and elbow. A prospective study of 51 cases. *J Hand Surg Br* 1996;21:237–43.
- [11] Leversedge FJ, Casey PJ, Payne SH, Seiler III JG. Vascular anatomy of the brachioradialis rotational musculocutaneous flap. *J Hand Surg Am* 2001;26:711–21.
- [12] Choudry UH, Moran SL, Li S, Khan S. Soft-tissue coverage of the elbow: an outcome analysis and reconstructive algorithm. *Plast Reconstr Surg* 2007;119:1852–7.
- [13] Roukoz S. Musculocutaneous flexor carpi ulnaris flap for reconstruction of posterior cutaneotricipital defects of the elbow. *Plast Reconstr Surg* 2003;111:330–5.
- [14] Raskin KB, Wilgis EF. Flexor carpi ulnaris transfer for radial nerve palsy: functional testing of long-term results. *J Hand Surg Am* 1995;20:737–42.
- [15] Lim AY, Kumar VP, Hua J, Pereira BP, Pho RW. The neuromuscular compartments of the flexor carpi ulnaris. *Plast Reconstr Surg* 1999;103:1046–51 [quiz1052–discussion1053].
- [16] Lim AYT, Pereira BP, Kumar VP, De Coninck C, Taki C, Baudet J, et al. Intramuscular innervation of upper-limb skeletal muscles. *Muscle Nerve* 2004;29:523–30.
- [17] Wysocki RW, Gray RL, Fernandez JJ, Cohen MS. Posterior elbow coverage using whole and split flexor carpi ulnaris flaps: a cadaveric study. *J Hand Surg Am* 2008;33:1807–12.